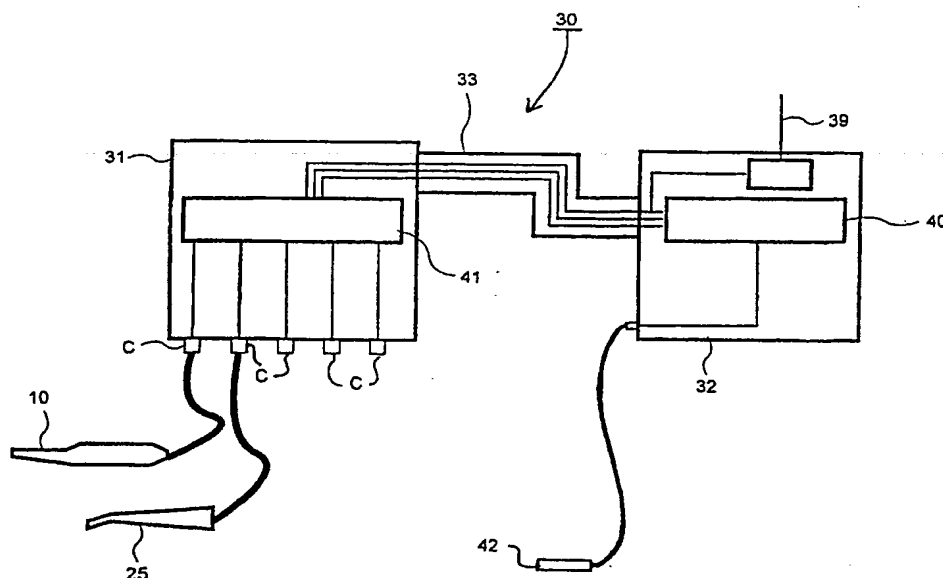




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(54) Title: IMAGING MEANS AND DENTAL UNIT**(57) Abstract**

The invention relates to an imaging means (10) suitable for recording images from the teeth and the mouth region. The imaging means (10) comprises an image-recording device such as a video camera, the optical components of an object illumination system, an instrument connection cable and a connector. The invention further concerns a dental unit (30) having one or more instrument connectors (C) onto which the control system of said dental unit (30) switches the physical variables required for the use of the instrument attached to said instrument connector. The invention also concerns a method of connecting an imaging means to a dental unit.

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Imaging means and dental unit

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The present invention relates to an imaging means particularly for recording images from the teeth and the mouth region, said imaging means comprising an image-recording device such as a video camera, an object illumination system, optical elements, an instrument connection cable and a connector.

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The invention also concerns a dental unit including at least one instrument connector, whereby the control system of the dental unit steers the physical variables related to the use of an instrument attached to said instrument connector. The invention further concerns a method of connecting an imaging means to a dental unit.

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An intraoral camera is an imaging means based on video image recording, most generally used by a dentist as an accessory for imaging the teeth and the mouth region and making a diagnosis on these anatomic regions. An intraoral camera facilitates accurate imaging of a single tooth, a part thereof or any other region of the mouth, complemented with a full-face picture. Pictures taken with an intraoral camera can be recorded in a storage means and, with the help of the stored pictures, the outcome of the care can be elucidated by comparing pictures taken before and after the care. In conjunction with an ongoing care, the intraoral camera can be utilized for showing the patient a specific part of the mouth needing care, thus motivating the necessity of the care for the patient.

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In conventional intraoral camera systems, the imaging means comprises a base unit and a hand-held imaging instrument, later in the text called a camera handpiece. The base unit typically includes a power supply, a control electronics unit and a light source. Further there is required a video monitor for displaying the image and possibly storage means for archiving the pictures. Light generated by the light source is generally taken from the base unit to the camera handpiece along a light guide.

Typically, the video camera circuitry is located in the base unit and the light-sensitive image sensor element in the handpiece. During an imaging session, the tip of the camera handpiece with its light output exit is taken close to the object to be imaged and the image is projected via the imaging optics onto the light-sensitive image sensor and further in an electrical format to the video camera electronics, and therefrom as a video signal to a display or storage means.

To avoid deterioration of image quality due to shadows, the illumination of the object to be viewed by an intraoral camera must be made as uniform as possible. Generally, light is launched onto the viewed object from the tip of the camera handpiece via an annular light output exit adapted to surround the imaging optics. The better the object illumination the smaller lens aperture of the video camera optics can be used, whereby the depth of field of view can be extended. Particularly for dental imaging, a large depth of field is an essential factor contributing to both the ease of operation and quality of imaging inasmuch the need for constant refocusing is eliminated.

Generally, an intraoral camera system comprises a separate, bulky base unit which causes problems to the positioning of the unit in the frequently cramped operating premises of a dentist. In conventional imaging means, the object illumination systems are very complicated inasmuch the light is transferred from the base unit along an optical light guide to the tip of the camera handpiece, whereby a considerable fraction of the light source output is lost on the light transmission path. Frequently, the output intensity of light exiting from the tip of the handpiece is insufficient to achieve a satisfactory depth of field. Moreover, the optical fiber extended from the base unit to the handpiece is subject to damage and makes the connection cable thick and stiff, whereby the handpiece located at the end of the connection cable becomes difficult to handle.

The problems associated with a separate base unit can be overcome by connecting the intraoral camera directly to the dental unit, whereby the existing functions of the dental unit can be utilized for the control of the imaging means. E.g., patent

publications EP 678 280 and DE 40 09 439 disclose embodiments in which the equipment manufacturer has already reserved one or a given number of instrument places on the dental unit console for connecting the imaging means. While in some constructions the user has an option of mounting the imaging means onto a desired instrument place through dismantling and reassembling the instrument console, obviously this arrangement is not compatible with the normal operating routine of a dentist. Conventionally, the dedicated instrument connectors do not support any other instruments than the imaging means and, conversely, the imaging means cannot be connected to any other instrument connector. These dental units lack the means for identifying the type of attached instruments and controlling the dental unit on the basis of such identification signals. However, for the convenience of the dental unit user it would be optimal to have all the required dental instruments to be quickly and effortlessly connectable to any desired instrument connector and, moreover, in any desired order - meaning that the dental unit should be equipped with general-purpose instrument connectors to which a camera or other dental accessory can be attached as desired. Particularly in dental clinics in which a greater number of dentists than one use the same dental unit alternately and each dentist desires to organize the order of their own instruments according to a preferred operating convenience, said novel type of dental unit facility is considered most welcome.

From patent publications EP 479 868, EP 110 200 and JP 192 3861, it is known to provide dental units with codable quick-connect connectors in which onto the connector pins can be switched the different physical parameters required to steer the instruments according to the operating situation. However, these prior-art dental units have not been equipped with facilities for connecting also an imaging means to such an instrument connector and for transferring the image signal via the instrument connector.

It is an object of the present invention to eliminate the above-mentioned drawbacks by virtue of providing a novel technique of connecting dental instruments to a dental unit.

It is a further object of the present invention to provide a novel connection technique of dental instruments by virtue of which method a dental unit can identify an imaging means or other dental instrument attached to a given instrument connector thereof and then switching the parameters and signals required for the control of said dental instrument to pass via said instrument connector of the dental unit.

It is still a further object of the present invention to provide a new type of imaging means such as an intraoral camera with advantageous properties suited for use in the above-described environment, whereby said imaging means does not require a separate base unit, but instead can be connected directly to a dental unit thus utilizing the existing functions of the dental unit.

It is a particular object of the invention to provide such an imaging means connection on a dental unit that, by virtue of said connection, to one and the same instrument connector can be attached either an imaging means or any other type of dental instrument, whereby all the instrument connectors of the dental unit can be equipped with said type of connection suitable for connecting different kinds of instruments thereto.

To achieve the above-described goals and others to be mentioned later in the text, the imaging means, dental unit and method according to the invention for connecting an imaging means to a dental unit are characterized by what is stated in the appended claims.

The benefits of the invention include that, in the combination of an imaging means with a dental unit according to the invention, the imaging camera can utilize the resources of the dental unit such as electricity, water, compressed air, control electronics and the instrument connectors themselves that are already provided for the needs of other dental instruments. According to the invention, the dental unit identifies the instrument attached to the instrument connector and switches thereon the physical variables required for any particular instrument function. As a further benefit of the invention may be mentioned that, via the instrument connector

according to the invention, the dental unit can receive information variables such as a video signal and perform further transfer thereof to, e.g., a display device.

For the identification of instruments, the specific identification signal can be
5 generated with the help of any conventional coding technique based on such elements as resistors, switches, etc. adaptable to function in conjunction with the instrument connector. Thus, the invention makes it possible to configure the imaging means with its connections, power feed and cooling medium circulation in a manner which is substantially more advantageous than prior-art combinations based on separate
10 devices and control systems. A still further benefit is that the dental unit may initially be equipped with a facility for connecting an imaging means, whereby the means such as a video camera itself be acquired later. Hence, a single camera can be swapped between a plurality of compatible dental units, whereby a dentist may operate in a number of separate dental units a single set of instruments, typically
15 owned by the dentist him/herself. The dental unit can be furnished with such instrument connectors that any type of instrument can be attached to any instrument connector provided with, e.g., a conventional multiplex interface. Alternatively, one or some instrument connectors may be exclusively assigned to serve a given instrument or a plurality thereof.

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The imaging means arrangement according to the invention is essentially characterized in that the object illumination system of the camera is adapted into the hand-piece portion of such an instrument. In the present arrangement, the light need not be conveyed over a long path, whereby light transmission losses are reduced and the
25 thick light guide can be omitted from the instrument cable.

An intraoral camera implemented according to the invention does not require a separate base unit, but instead, the camera can be integrated with a conventional dentist's dental unit. Thus, the intraoral camera may be designed into a miniature
30 device that is readily available in parallel with other dental instruments. The electrical supply and cooling medium of the intraoral camera can be furnished from the dental unit.

In the following, the invention is described in greater detail with reference to preferred embodiments thereof having a nonlimiting character to the scope and spirit of the invention that are illustrated in the appended drawings in which

5 Figure 1A shows an intraoral camera suitable for use in the invention;

Figure 1B shows the light source section of the intraoral camera illustrated in Fig. 1A;

10 Figure 2 shows a dental unit according to the invention having a plurality of dental instruments attached thereto;

Figure 3 shows a preferred technique of transferring the image information signal through the dental unit; and

15

Figure 4 shows a connector arrangement according to the invention equipped with an instrument-identifying facility.

Now referring to Fig. 1A, therein is shown an intraoral camera 10 housing a camera
20 section 11, a light-sensitive image sensor element 12, an optical section 13, an image-orientation-mirroring element 14, a front-end optics section 15, a light source section 16, a cooling element 20, a light guide 18 and a sensor element 22. Additionally, the intraoral camera 10 includes an instrument connection cable 23 with a connector 24 placed at the other end of said cable.

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During an imaging session, the illumination on the imaged object is furnished from the light source section 16 wherefrom the light travels along a light guide 18 to the front end of the intraoral camera 10. There, the light is launched via a plurality of exit points in order to obtain a maximally smooth illumination on the object to be
30 imaged. Inasmuch the light source section 16 is thus located close to the exit point of object illumination, the length of the light guide 18 becomes so short that no substantial losses will occur over the transmission path of the illuminating light.

The assembly of the light source 16 and elements enclosing the same is shown in greater detail in Fig. 1B. The front end of the light source 16 contains a condenser lens 19 and a reflector 17 surround the light source. The condenser lens 19 directs the object-illuminating light forward and the reflector 17 surrounding the light source
5 gathers the light emitted by the light source with maximum efficiency thus reducing light losses and improving illumination intensity at the object.

The light source 16 can be implemented using a lamp of relatively low input power, whereby the heat of the lamp can be absorbed by a cooling element 20 surrounding the lamp. From the cooling element 20, the heat is removed by means of a cooling
10 medium that in the exemplifying embodiment is compressed air available from the dental unit. The function of cooling by compressed air is to prevent the lamp heat from reaching the camera and its CCD image sensor that are located close to the lamp, because an elevated operating temperature of the camera would otherwise
15 deteriorate the signal-to-noise ratio of the camera output signal.

The output intensity of the light source 16 can be adjusted by controlling the operating voltage of the lamp. This arrangement helps avoid situations causing saturation of the camera sensor and thus contributes to higher image quality.
20

The image of the object is projected onto the light-sensitive image sensor 12 of the camera over a path comprising the front-end optics 15, an optical image-mirroring element 14 and further the internal optical system 13 located in the front end of the intraoral camera 10. The optical image-mirroring element 14 flips the image
25 orientation in a so-called penta prism that corrects the image orientation already before the image reaches the camera section 11 thus disposing with the need for correcting the image orientation in the post-processing steps of the camera signal. The image focus is controlled with the help of the optical section 13 by adjusting a control knob (not shown in the diagram) placed on the intraoral camera head.

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The optical section 13 may be implemented as a constant-magnification lens system or, alternatively, including a zoom facility.

The light-sensitive image sensor element 12 may be, e.g., a CCD-type solid-state camera sensor. The light-sensitive image sensor element 12 converts the optical image projected thereon into a video signal and transfers the signal to the camera section 11, wherefrom the outgoing video signal travels over a conductor of the instrument connection cable 23 to the cable connector 24. The camera section may
5 be implemented using, e.g., a video camera, but also other type of imaging means is also feasible. The camera optics is provided with an adjustable aperture stop.

The intraoral camera 10 may include a sensor element 22 by means of which the
10 dental unit can detect the removal of the intraoral camera 10 from its storage support, that is, the use thereof. Such a sensor element 22 can also be utilized to produce a signal on the return of the camera into its storage support, that is, on the end instant of camera use. Also other dental instruments can be equipped with a sensor element 22. This type of element 22 may be, e.g., a reed relay or a Hall
15 sensor, both capable of being activated by a strong magnetic field. Besides being suitable for use in the instrument console proper of a dental unit, it can also be applied to separate storage racks which are placed apart from the instrument console of the dental unit. Such a separate rack can be placed in a desired location within the dentist's operating room.

20 The electrical supply of the intraoral camera and the cooling medium, advantageously compressed air, required for cooling the light source 16 are passed via the connector 24 and the instrument connection cable 23. The video signal is passed via the instrument connection cable 23 and the connector 24 to the dental unit 30.
25 According to the invention, the connector 24 is of the same type as those of the other dental instruments attached to the dental unit 30.

In Fig. 2 is shown an embodiment of a dental unit 30 according to the invention. In the present context, the term dental unit is used in reference to a means, capable of
30 having at least one instrument 25 attached thereto suitable for use in dental care and having facilities for feeding electrical supply, water and/or compressed air to said instruments 25. The dental unit 30 includes an instrument console 31, a body unit 32

and a cable conduit 33 joining these two. The cable conduit 33 is suitable for passing therethrough the electrical conductors, signal lines and the water/air supply hoses of the unit. The instrument console 31 contains an electronics unit 41 with functions required for controlling the dental instruments. The body unit 32 contains an electronics unit 40 housed in the body unit, a connection for a foot control unit 42 and a video signal output 39.

The instrument console 31 of the dental unit 30 shown in Fig. 2 includes a plurality of mutually identical connectors C, suitable for connection of dental instruments 25 and the intraoral camera 10 according to the invention. Any instrument can be attached to any of the connectors C. In the illustrated embodiment of the dental unit, thereto is connected an intraoral camera 10 and a dental instrument 25. The dental instrument 25 may contain, e.g., a turbine or micromotor. The dental unit 30 identifies each instrument 10,25 being attached thereto and the electronics unit 41 of the dental unit 30 controls the physical operating parameters according to the needs of each instrument 10,25. For instance, when the intraoral camera 10 is being used, the supply voltage and cooling medium required thereto can be controlled to correct values and the image information signal produced by the camera is switched to the output 39.

The instrument being used can be controlled by means of a foot control unit 42 placed on the floor. As the dental unit 30 is aware of the type of instrument 10, 25 being used, the unit can convert the signals issued with the foot control unit 42 into correct command signals to control said instrument 10,25 in particular. An example of such use of the foot control unit 42 is a situation in which the intraoral camera 10 is in use and the foot control unit 42 can be activated to make the camera record a still picture.

According to the invention, the operation of the imaging means 10, the instruments 25 and the foot control unit 42 is advantageously steered via the operator interface of the dental unit 30.

A preferred arrangement according to the invention is to equip all the connector positions C with the universal interface connector with the exception of one connector that is left for a specific use serving only the syringe.

- 5 In Fig. 3 is shown a possible arrangement for passing the image information signal through the dental unit 30 up to the signal output 39. In this embodiment, only the most lateral instrument connector C is equipped suitable for accepting both the imaging means 10 as well as other types of instruments 25. The signal produced by the imaging means 10 is passed via the instrument cable 23, its connector 24 and the
10 connector C of the dental unit 30 to the circuitry of the dental unit 30. In this chain, the signal is first passed to a modulator 34 wherein it is upconverted to a higher carrier frequency. The modulated signal is taken over a conductor 35 to a cable 36 which is primarily adapted to serve a different task as, e.g., an electric supply cable. However, passing the modulated video signal simultaneously along a cable 36
15 serving a duty does not interfere with the primary function of the cable 36. Transmission of the image information signal in this manner is an advantageous arrangement inasmuch it disposes with the need for installing a separate auxiliary cable in the already cramped conductor conduit 33. The modulated signal is next passed in the conductor conduit 33 between the instrument console 31 and the body unit 32 to
20 the interior of the body unit 32, where the modulated signal is passed over a conductor 37 to a demodulator 38. Therefrom the signal is further passed to the video signal output 39, and therefrom to, e.g., a video monitor for display and/or to a storage means.
- 25 In Fig. 4 is shown a possible connector construction according to the invention. It must be noted that the identification of an instrument in accordance with the invention need not, within the scope and spirit of the invention, be necessarily implemented using the technique described herein, but any other corresponding embodiment can be employed as well. As shown in Fig. 4, the quick-connect connector 24 of the
30 instrument connection cable 23 of the imaging means 10 or any other dental instrument 25 is attached to an instrument connector C according to the invention on the instrument console 31 of the dental unit 30. Herein, e.g., one of the connector pins

26 is connected to communicate with means serving to identify the instrument 10, 25 attached to said instrument connector C. This kind of identification may be based on, e.g., a resistor of a specific resistance which is placed in the connector 24 so as to communicate with such a connector pin 26' (not shown in the diagram) of the connector 24 that upon the mating of the connector 24 with the instrument connector C meets said instrument-identifying connector pin 26. As the dental unit 30 thus identifies the specific type of instrument 10, 25 attached to said instrument connector C, it can correctly switch the specific physical variables required by said instrument 10, 25 to be available at said instrument connector C.

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In the embodiment shown in Fig. 4, the video signal can be passed to the dental unit 30 via any of the connector pins 26. Particularly according to the invention, it is possible to utilize the individual connectors pins 26 for transferring different types of signals as required by the actual operating situation and/or to adapt an individual connector pin 26 for simultaneous transfer of a plurality of signals modulated to different carrier frequencies.

The above-given description must be understood to represent only a few preferred embodiments of the invention whose details may be varied within the scope and spirit of the invention. For instance, techniques different from those employed in the above examples for transferring the image information signal from the instrument connector to the display and/or image storage device may be contemplated. The scope of the invention is defined in the appended claims.

25

Claims

1. Imaging means for recording images from the teeth and the mouth region, said imaging means (10) comprising an image-recording device (11) such as a video camera, an illumination system (16,17,18,19), optical elements (13,14,15), an instrument connection cable (23) and a connector (24), said imaging means (10) being arranged connectable to an instrument connector (C) of a dental unit (30) via an instrument connection cable (23) and a connector (24), whereby at least a portion of the physical operating variables required to control said imaging means (10) are available from said dental unit (30) and the video signal produced by said imaging means (10) can be passed to a display and/or an image-recording device, **characterized** in that said imaging means (10) includes elements such that, upon connection of said means to an instrument connector (C) of said dental unit (30), can provide a specific identification signal such that said dental unit (30)
- identifies particularly the connection of said imaging means (10) to said instrument connector (C) and
 - can switch onto said instrument connector (C) the specific physical variables such as a correct electrical supply voltage and/or compressed-air supply required for the operation of said instrument (10) and, if so needed, can also switch a signal path for receiving the image information signal produced by said imaging means.
2. Imaging means according to claim 1, **characterized** in that its connection to said instrument connector (C) forms a conventional multiplex connection.
3. Imaging means according to claim 1 or 2, **characterized** in that its object illumination system (16,17,18,19) is adapted coolable by a cooling medium, advantageously compressed air.

4. Imaging means according to any of claims 1—3, **characterized** in that said cooling medium is passed from said dental unit (30) via an instrument connection cable (23).
- 5 5. Imaging means according to any of claims 1—4, **characterized** in that the light source (16) of its object illumination system (16,17,18,19) is surrounded by a reflective material in order to maximize the collection efficiency of light source output.
- 10 6. Imaging means according to any of claims 1—5, **characterized** in that the image illumination system (16,17,18,19) thereof is equipped with a light source having a light output adjustable to cope with the brightness of the recorded image.
- 15 7. Dental unit with facilities permitting its different instrument connectors (C) to be used for establishing a connection between said dental unit (30) and an imaging means (10) as well as between said dental unit (30) and dental instruments (25) such that an image information signal, e.g., a video signal, produced by said imaging means (10) can be passed to a display and/or image-recording device, and said dental unit (30) having its control system equipped with means for switching the
- 20 specific physical variables required for the operation of said instrument to be available at said instrument connectors (C), **characterized** in that at least one of said instrument connectors (C) of said dental unit (30) is equipped with a facility of attaching either said imaging means (10) or any other dental instrument (25) by virtue of having said dental unit (30) equipped with
- 25 — means for identifying at said instrument connector (C) the connection thereto of an instrument such as an imaging means (10) or any other dental instrument (25) on the basis of an instrument-specific connection signal generated at said instrument connector (C), and
- 30 — means for switching onto said instrument connector the specific physical variables required for the operation of said instrument (10,25) attached to said instrument

connector and, if so needed, a signal path for receiving the image information signal produced by said imaging means (10).

8. Dental unit according to claim 7, **characterized** in that the connection of an imaging means (10) or any other dental instrument (25) to said instrument connector (C) forms a conventional multiplex connection.

9. Dental unit according to claim 7 or 8, **characterized** in that all or, alternatively, all but one of said instrument connectors (C) are provided with means facilitating said type of connection.

10. Dental unit according to any of claims 7—9, **characterized** in that said imaging means (10) is compatible with the specifications defined in claims 1—6.

11. Dental unit according to any of claims 7—10, **characterized** in that its operator interface is adapted suitable for controlling said imaging means (10) or an accessory associated with imaging.

12. Dental unit according to any of claims 7—11, **characterized** in that said dental unit includes a modulator (34) and a demodulator (38) suitable for processing an image information signal and means for transmitting said signal in a modulated form.

13. Dental unit according to any of claims 7—12, **characterized** in that the instrument connectors (C) of said dental unit contain connector pins (26) adapted suitable for use in the transmission of different signals according to the actual operating situation and/or that the same said connector pins (26) are adapted suitable for simultaneous transfer of a plurality of signals modulated to different carrier frequencies.

14. Dental unit according to any of claims 7—13, **characterized** in that the instrument console (13) or a similar storage facility of instruments of said dental unit

includes means suited for the identification of and for the production of a signal thereon that an imaging means (10) or a dental instrument (25) is inserted in its storage place or, conversely, is removed therefrom; in other words for detecting the situations when said instrument (10,25) is taken in use and, conversely, when its use
5 has ceased.

15. Dental unit according to claim 14, **characterized** in that said dental instrument (25) and/or imaging means (10) contains a sensor element (22), said sensor element (22) being, e.g., a reed relay or a Hall sensor, said sensor element (22) serving to
10 issue a signal on which is based the detection of the situation related to the start and end instants of instrument use.

16. Dental unit according to any of claims 7—13, **characterized** in that said dental unit includes means for switching onto said instrument connector (C) the physical
15 variables required for the use of said imaging means (10) or said dental instrument (25) as soon as said instrument (10,25) has been detected taken into use and, conversely, switching said physical variables off from said instrument connector as soon as the use of said instrument (10,25) has been detected ceased.

20 17. Method of connecting an imaging means to a dental unit, **characterized** in that said method comprises following steps:

— said dental unit (30) is equipped with instrument connection connectors (C) of which at least one is suited for attaching either an imaging means (10) or any other
25 type of dental instrument (25),

— said imaging means (10) is attached to said type of instrument connection connector (C),

30 — said imaging means (10) is identified attached to said instrument connection connector,

whereby, either immediately thereby or only after said imaging means (10) has been taken in use,

5 — onto said instrument connector (C) are switched the specific physical variables required for operating said imaging means (10) such as a correct electrical supply voltage and/or compressed-air supply and, if so needed, a signal path for receiving the image information signal produced by said imaging means (10).

10 18. Method according to claim 17, **characterized** in that the physical variables associated with the use of said imaging means (10) are passed via the connector pins (26) of said instrument connector (C).

15 19. Method according to claim 18, **characterized** in that different types of signals are passed via said connector pins (26).

20 20. Method according to claim 19, **characterized** in that via a single connector pin (26) are passed signals modulated to different carrier frequencies and/or said signals of different carrier frequencies are passed via said connector pin simultaneously.

20 21. Method according to any of claims 17—20, **characterized** in that the control of said imaging means (10) or an accessory associated with imaging is performed using the operator interface of said dental unit (30).

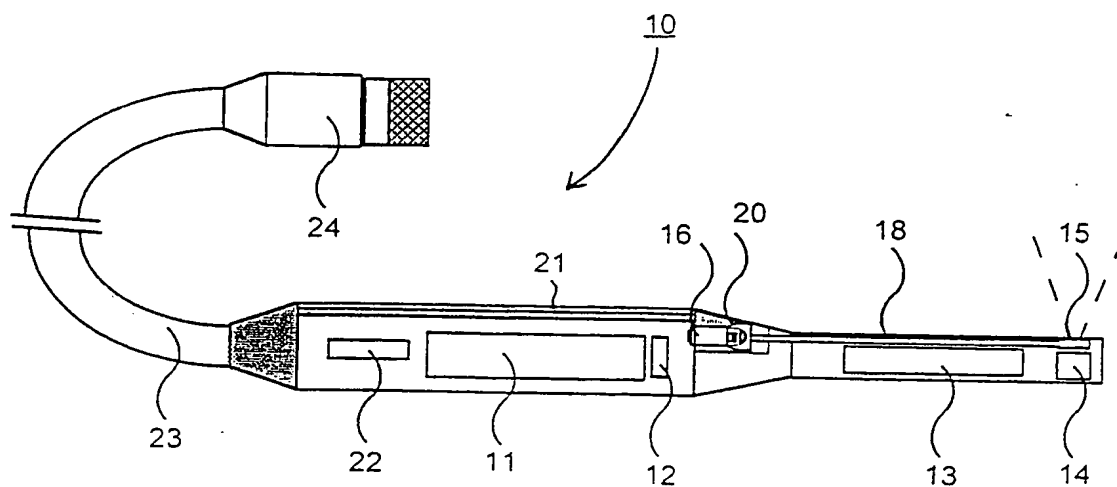


FIG. 1A

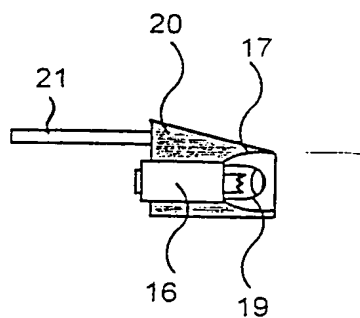


FIG. 1B

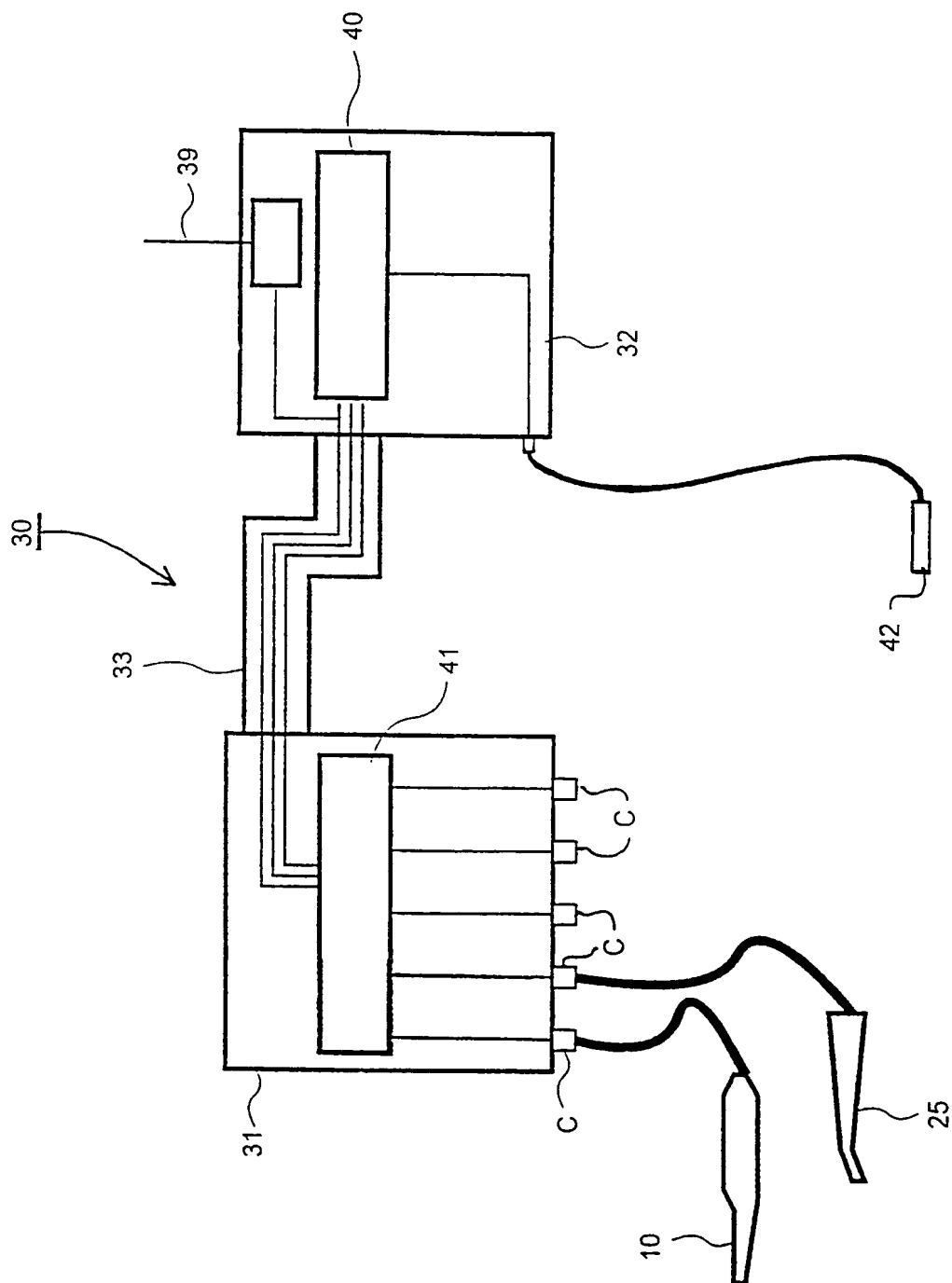


FIG. 2

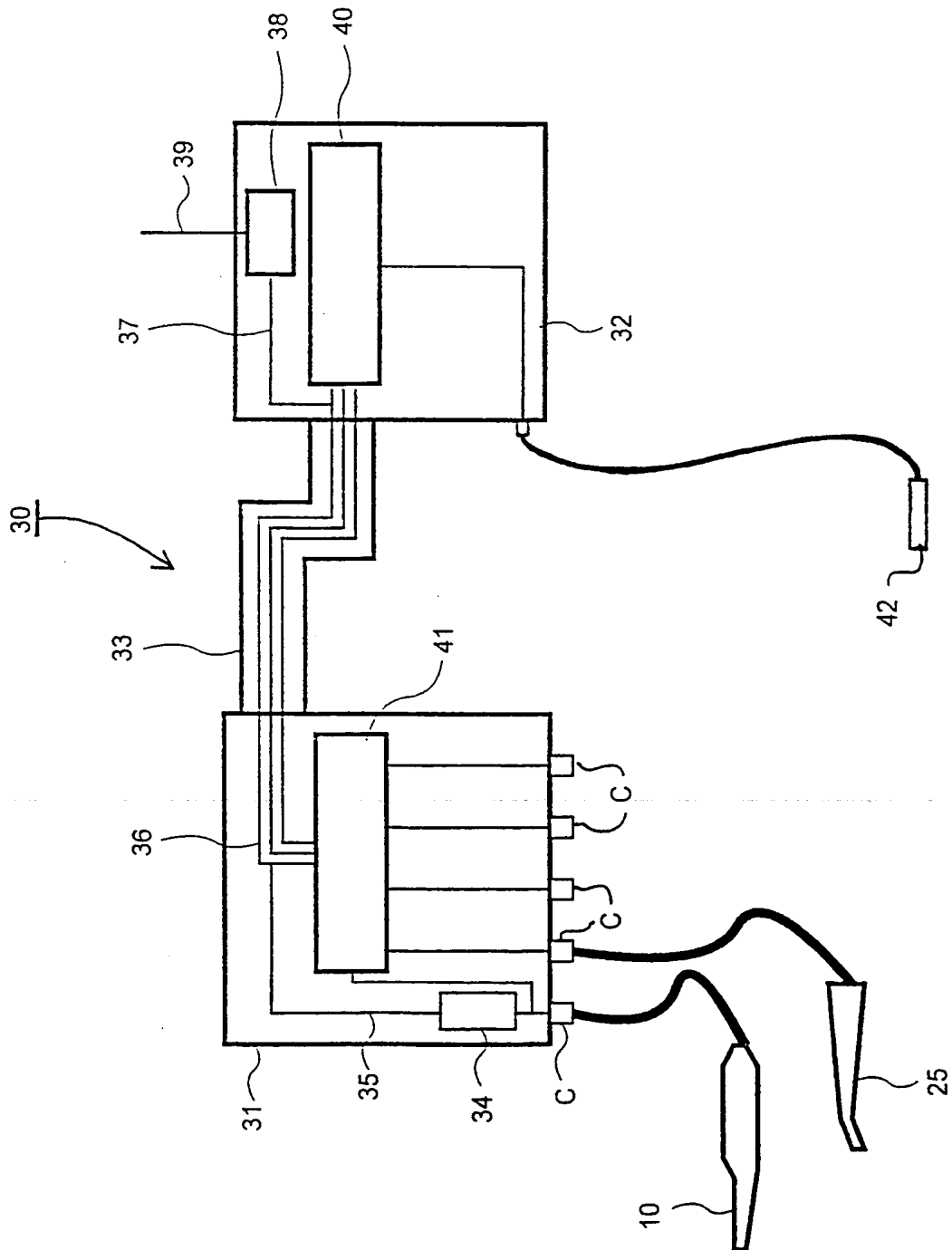


FIG. 3

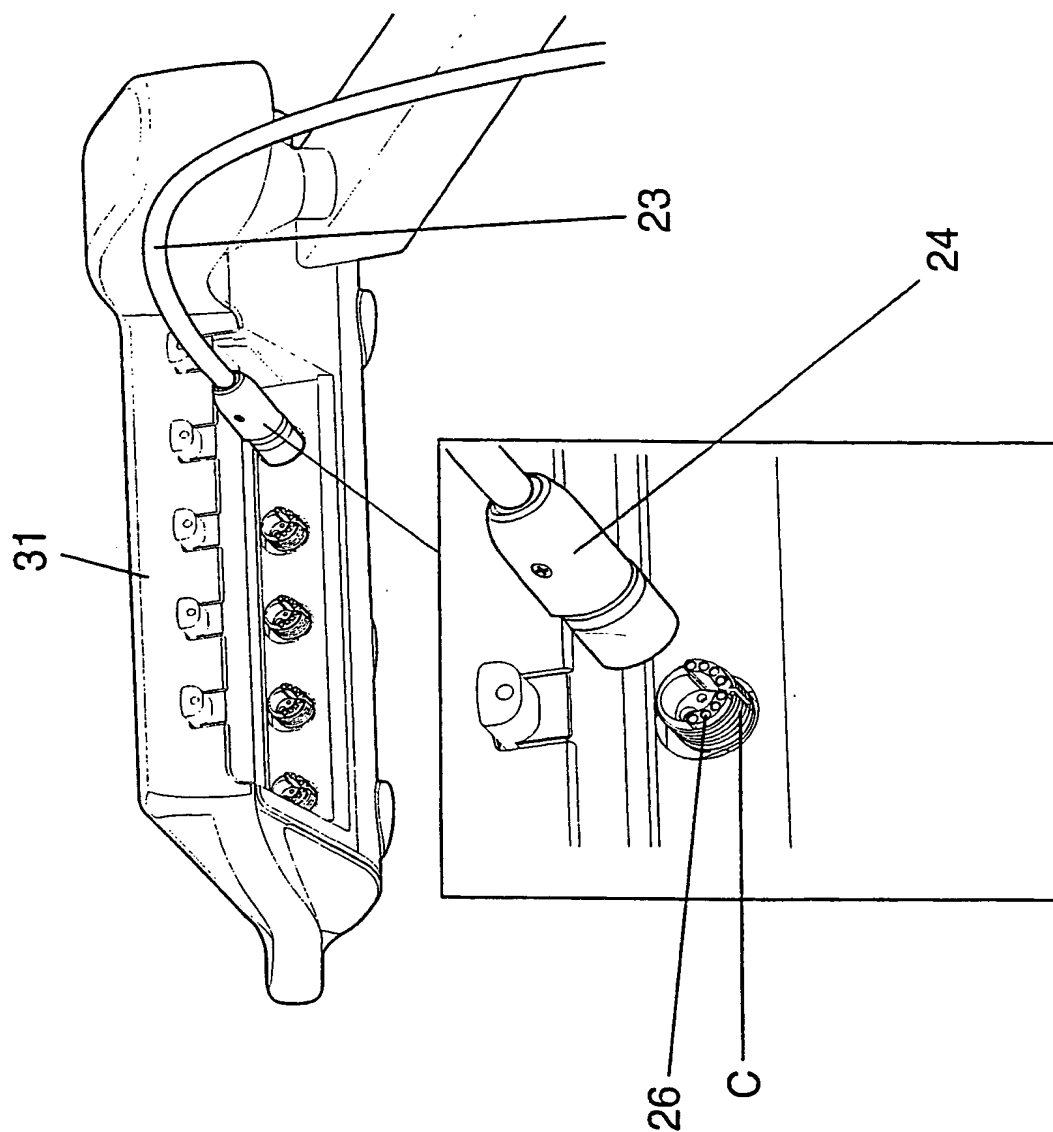


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 98/00930

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: A61C 1/00, A61B 1/04 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC6: A61C, A61B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0678280 A2 (SIEMENS AKTIENGESELLSCHAFT), 25 October 1995 (25.10.95) --	1-22
A	DE 4009439 A1 (KALTENBACH & VOIGT GBMH & CO.), 26 Sept 1991 (26.09.91) --	1-22
A	US 5634790 A (RAVI PATHMANABHAN ET AL), 3 June 1997 (03.06.97) --	1-22
A	WO 9100067 A1 (DEN-FLEX A/S), 10 January 1991 (10.01.91) -- -----	1-22
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
31 March 1999		07 -04- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86		Authorized officer Jack Hedlund Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

02/03/99

International application No.

PCT/FI 98/00930

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US 5634790 A	03/06/97	EP 0821907 A US 5743731 A	04/02/98 28/04/98
WO 9100067 A1	10/01/91	DE 69002163 T DK 161490 B,C DK 320689 A EP 0479868 A,B ES 2043382 T FI 916149 D JP 4506310 T	25/11/93 15/07/91 29/12/90 15/04/92 16/12/93 00/00/00 05/11/92